Semester IV

Fire Hydraulics and Suppression System

1.1 Course Number: FSE207
1.2 Contact Hours:3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Fire Codes and standards (3rd Semester)
1.5 Syllabus Committee Members: Ms. Ananya Borah &Dr. Nilambar Bariha

2. Objective:

i) To provide in depth knowledge of various fire suppression agents and extinguishing Mechanisms.
ii) To gain knowledge on basic components of Fire Suppression System and its application.
iii) To provide an overview of basic Principles of Fire Hydraulics and its calculation.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Suppression Agents and Extinguishing Mechanisms**	Overview of suppression and extinguishment, Suppression agents/attributes, Portable Fire Extinguishers-Classifications of portable fire extinguishers, testing of portable fire extinguishers. Standpipe and Hose Systems - Basic components of standpipe and hose systems, Types of systems/ components/applications.	8
2	**Water and Foam based Suppression System**	Basic components of water and foam-based suppression systems. Types of water and foam suppression systems/components and its applications. Attributes of system components, Hazard classifications/System design criteria, Spacing/location /placement of discharge devices.	8
3	**Carbon Dioxide Suppression System**	Basic components of Carbon dioxide-based suppression systems- Carbon dioxidebased suppression system operation-Standard for Carbon dioxidebased suppression systems-Types-Types- Local application system- Total Flooding system-Inspection, Testing and maintenance. Hazards of Carbon dioxide-based suppression system.	8
4	**Dry Chemical and Wet Chemical Suppression System**	Basic components of Dry chemical & Wet chemical Suppression system- Fixed Dry chemical & Wet chemical Suppression system operation-Standards for Dry chemical & Wet chemical Suppression system-Types- Local application system- Total Flooding system-Inspection, Testing and maintenance.	9
5	**Hydraulics Systems**	Overview of hydraulics-Definition “hydraulics” in fire protection Engineering, basic Principles of Hydraulics and its calculation, Water Supply Analysis, types of water supply, Hydraulics of Water Supplies for Automatic Sprinkler Systems. Principles of water flow in a piping system and through an orifice, Concept of friction loss and determine friction loss. Fire water demand for calculation for process plants.	9
Total			**42**

4. Reading

4.1 Textbooks/ Reference Books:

1. Watts, J.M., Hall, J.R., SFPE Handbook of Fire Protection Engineering, National Fire Protection Association Quincy, Massachusetts, (Society of Fire Protection Engineers, Boston), 3rd Edition, 2002.
2. Bromann, M., The Design and Layout of Fire Sprinkler Systems, Tyalor & Francis, CRC Press, 2nd Edition, 2001.
3. OISD-115 (Oil Industry Safety Directorate), (2002). Guidelines on Fire Fighting Equipment and Appliances in Petroleum Industry. <http://www.oisd.nic.in/oisd-std-115>.
4. OISD-116 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Refineries and Oil/Gas Processing Plants. <http://www.oisd.nic.in/oisd-std-116>.
5. OISD-117 (Oil Industry Safety Directorate), (2017). Fire Protection Facilities for Petroleum Depots, Terminals, Pipeline Installations & Lube oil installations. <http://www.oisd.nic.in/oisd-std-117>.
6. OISD-142 (Oil Industry Safety Directorate), (1996). Inspection of fire-fighting equipments and systems. <http://www.oisd.nic.in/oisd-std-142>.
7. Lamalva, K.J., Hopkin, D., Structural Fire Engineering, Fire Protection Committee, American Society of Civil Engineers, 2018.
8. NFPA-13 (National Fire Protection Association), (2000). Standard for the Installation of Sprinkler Systems. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards>
9. NFPA-15 (National Fire Protection Association), (2000). Standard for Water Spray Fixed Systems for Fire Protection. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards>

5. Outcome of the Course:

On completion of this course, the students will be able to

i) Know the active and passive fire protection design and precaution in building or other industries/ premises.
ii) Demonstrate the usage of various fire suppression system during any emergency
iii) Calculation of fire water demand for various hazardous installations.

Fire Dynamics

1.1 Course Number: FSE208
1.2 Contact Hours:3-0-0 Credits: 9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Engineering Thermodynamics
1.5 Syllabus Committee Members: Dr. Nilambar Bariha & Ms. Ananya Borah

2. Objective:

i) To understand about the combustion, chemistry, mass conversation, and its flame spread in the surrounding.
ii) To explain about the burning properties of materials, detail fire behaviour of materials, and building fire.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Combustion Fundamentals**	Chemical Thermodynamics and kinetics, Pyrolysis, ignition and combustion, conservation equations for mass, momentum, energy and species, turbulence, radiation.	8
2	**Ignition of Flaming Combustion**	Introduction, flashpoint, dynamics of evaporation, evaporation rates, Clausius-Clapeyron equations, estimate of ignition time components-Chemical time, mixing time, pyrolysis, ignition in thermally thin and thick solids, ignition properties of common materials, Heat flux in fire.	10
3	**Fire Dynamics**	Flames and fire spread theory, buoyant plumes, and interactions with surfaces, smoke spread, turbulent diffusion flames, soot formation and radiation effects, toxic products; fire chemistry, nitrogen and halogen thermochemistry, numerical techniques.	12
4	**Compartment Zone Fires**	Flashover, post-flashover, control, applications, numerical techniques, plume and ceiling jet models.	4
5	**Heat Transfer in Fire**	Heat transfer concepts, Forms of heat transfer, conduction-Steady state condition, thermal penetration time, convection and radiation-hot gases and smoky gases, heat flux from flames, heat flux as an indication of damage.	8
Total			**42**

4. Reading

4.1 Reference Books:

1. Drysdale, D.D., An Introduction to Fire Dynamics, Wiley, New York, 1999.
2. Lyons, J.W., Fire, Scientific American Books, New York.
3. Karlsson, B., and Quintiere, J.G., Enclosure Fire Dynamics, CRC Press.
4. Cox, G., Combustion Fundamentals of Fire, Academic Press, London, 1995.
5. Haessler, W.M., Fire: Fundamentals and Control, Marcel Dekker, 1988.
6. SFPE, Handbook of Fire Protection Engineering, NFPA, Quincy, Mass.
7. Quintiere, J.G., Principles of Fire Behavior, Delmar, 1985.

5. Outcome of the Course:

Students will be able to

1) Understand the fire dynamics in building or forest fire.
2) Understand the basic of properties of burning of material and its chemical kinetics.
3) Design the building as per fire safety requirements.

Fire Detection System and Electrical Safety

1.1 Course Number: FSE209
1.2 Contact Hours:3-0-0 Credits:09
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Fundamentals of Electrical and Electronics Engineering
1.5 Syllabus Committee Members: Ms. Ananya Borah &Dr. Nilambar Bariha

2. Objective:

i) To provide an overview of Fire alarm & detection system used in various Industrial installations.
ii) To provide in-depth view of electrical safety at workplace as per national/international standards, codes and/or rules.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Fire Detection System**	Introduction of detection devices, Alarm and detection system, Basic function of Fire alarm & detection system-Type of detectors- Smoke Detector-Smoke detector Classification-Heat detector – Heat detector Classification- Flame Detector-Flame Detector Classification-Method of selection- Working Principle-Advantages and disadvantages of various detection devices.	9
2	**Introduction about Electrical Safety and Management**	Introduction – electrostatics, electromagnetism, stored energy, energy radiation and electromagnetic interference –Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation (CPR).	8
3	**Electrical Hazards**	Primary and secondary hazards - shocks, burns, scalds, falls - Human safety in the use of electricity - Classes of insulation-voltage classifications -current surges- over current and short circuit current-heating effects of current electrical causes of fire and explosion. Lightning hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.	9
4	**Electrical Protection Systems**	Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines - overload and short circuit protection. Earth leakage circuit breaker (ELCB) - use of low voltage-electrical guards-Personal protective equipment. Role of environment in selection- protection and interlock self-diagnostic features and fail-safe concepts-lock out and work permit system - safety in the use of portable tools-cabling and cable joints-preventive maintenance.	9

5	**Hazardous Zones**	Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification- use of barriers and isolators.	7
Total			**42**

4. Reading

4.1 Reference Books:

1. Rao, S., Electrical Safety Fire Safety Engineering and Safety Management, Khanna Publications, 2nd Edition, 2012.
2. Fordham Cooper, W., Electrical Safety Engineering, Butterworth and Company, London, 2006.
3. Indian Electricity Act and Rules, Government of India.
4. Cadick, J., Electrical safety Handbook, Third Edition, McGraw Hill, 2006.

5. Outcome of the Course:

1) Describe the phenomenon of electrical hazards associated causes, effects and prevention/protection measures.
2) Identify hazardous areas/locations in a given industrial site for selection, installation, operation and maintenance of electrical equipment.
3) Explain the working principles and applications of various kinds of Fire alarm & detection system.

Safety in Construction

1.1 Course Number: FSE210
1.2 Contact Hours:3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: NA
1.5 Syllabus Committee Members: Ms. Ananya Borah &Dr. Nilambar Bariha

2. Objective:

i) To provide knowledge of various safety practices followed in construction site.
ii) To provide in-depth knowledge of various work carried in construction site.
iii) To familiarize the student applicable Statutory regulations, acts, regulations.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Accidents Causes and Management Systems**	Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accidents – The Building and other Construction workers (Regulation of Employment and conditions of Service) Central Rules, 1998, Contract document & contractual clauses Precontract activities, preconstruction meeting–Project HSE Plan-design aids for safe construction, permits to work, Personal protective equipment, Recording of accidents and safety measures, Education and training.	9
2	**Hazards of Construction and Prevention**	Excavations, Trenches, Erection of structural framework, dismantling–tunneling–blasting, confined spaces–working on contaminated sites–workover water Safety during Demolition–Cordoning–Dismantling–Clearing debris Housekeeping – accidents due to poor housekeeping.	9
3	**Fall Prevention and Fall Protection**	Fall prevention and fall protection - Fall protection in construction – OSHA requirement for working at heights, Different types of scaffolds – Design, safe erection, use and dismantling, scaffold inspection checklist, requirement for safe work platforms, stairways and ramps. Safe access and egress – safe use of ladders- Safety Harnesses, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, Height pass –accident case studies.	8
4	**Safety in Huge Structures**	Safety in typical civil structures – Dams-bridges-water Tanks-Retaining Walls-Critical factors for failure-High rise buildings, Road works, and Power plant constructions.	8
5	**Construction Machinery**	Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder's hoist, winches, chain pulley blocks–use of conveyors concrete mixers, concrete vibrators–safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader,	8

		concrete pumps, welding machines, use of portable electrical tools, Inspection and Maintenance, Hand tools, Manual Material handling.	
Total			**42**

4. Reading

4.1 Reference Books:

1. Mishra, R.K., Construction Safety Paperback, 2013.
2. Herberle, D., Construction Safety Manual, McGraw-Hill, 1998.
3. Holt, A.S., Principles of Construction Safety Paperback, 2005.

5. Outcome of the Course:

On completion of this course the student will be able to:

1) Understand the safety requirements in various construction operations and develop guidelines to ensure safety at construction site.
2) Learn and apply the legal provisions with respect to the health and welfare of workers at construction site.
3) Understand the safety requirements in material handling and equipment's and develop guidelines to ensure safety at construction site.

Heat Transfer Operations

1.1 Course Number: FSE211
1.2 Contact Hours:3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Diploma-level Mathematics and Physics
1.5 Syllabus Committee Members: Dr. Nilambar Bariha & Ms. Ananya Borah

2. Objective:

i) To comprehend the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment used in process industries.
ii) To explore the radiative properties of different media.
iii) To recognize the significance of heat transfer from flames or hot gases impinging on surfaces.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Introduction**	Heat and Modes of heat transfer: Conduction, Convection, Radiation, Concept of steady state and unsteady state heat transfer, Analogy between flow of heat and electricity.	7
2	**Conduction**	Thermal conductivity, Fourier's law of heat conduction, Steady state equation, Heat flow equation for composite walls, Composite cylinders, Spheres, Insulation and insulating materials, Critical insulation thickness.	9
3	**Convection**	Nature of heat convection, Dimensional analysis and significance of various dimensional groups, Forced convection (No derivation), Free convection (No derivation)	8
4	**Thermal Radiation**	Nature of thermal radiation, Absorption, Transmission, Reflection and Emission of radiation, Emissive power of black body, Plank's distribution, Total emissive power, Stefan-Boltzman law, Emissivity, Kirchoff's law, Black body, Wien's displacement law.	9
5	**Heat Transfer in Fire**	Fundamentals of heat transfer, modes of heat transfer and its measurements, Techniques used to measure temperature. Specific convective studies, Basic principle of Radiative transfer, Methods for calculating radiation from flame to target.	9
TOTAL			**42**

4. Reading

4.1 Textbooks:

1. J. P. Holman, Heat Transfer, McGraw - Hill.
2. B. K. Dutta, Heat Transfer, Prentice Hall of India.
3. Quintiere, J.G., Principles of Fire Behavior, Delmar, 1985.

4.2 Reference Books:

1. D.Q. Kern, Process Heat Transfer, Tata McGraw - Hill.
2. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, McGraw-Hill.
3. Karlsson, B., and Quintiere, J.G., Enclosure Fire Dynamics, CRC Press

5. Outcome of the Course:

Students completing the course will be able to:

i) Understand the fundamental laws of conduction, convection, and radiation, along with their applications in heat transfer.

ii) Analyze convective heat transfer, including heat transfer coefficients for natural and forced convection in fires, and assess heat transfer between fire, fire gases, the fuel bed, and surrounding surfaces.

iii) Evaluate the impact of heat transfer from flames and hot gases on the overall energy balance and fire hazard assessment.

Incident Investigation and Safety Audit

1.1 Course Number: FSE212
1.2 Contact Hours:3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Health, Safety and Environment
1.5 Syllabus Committee Members: Ms. Ananya Borah & Dr. Nilambar Bariha

2. Objective:

i) To give students a foundation on theories of accident causation and prevention methods.
ii) To carry out systematic accident investigations to identify the root causes.
iii) In-depth learning of inspection, auditing process, fire investigation & fire risk assessment.

3. Course Content:

	Unit-wise distribution of content and number of lectures		
Unit	**Topics**	**Sub-Topic**	**Lectures**
1	**Introduction to Safety Management**	History of Safety movement-Evolution of modern safety concept- general concepts of management –line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.	8
2	**Safety Audit**	Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor-IS14489 : 1998 Code of practice on occupational Safety and health audit.	9
3	**Accident Investigation and Reporting**	Concept of an accident, near miss incident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – role of safety committee –cost of accident.	9
4	**Safety Performance Monitoring**	Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety	8

		activity rate, Total Injury illness incidence rate, lost workday cases incidence rate (LWDI), Number of lost workday's rate– problems.	
5	**Safety Education Training**	Importance of training-identification of training needs-training methods – programmes, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training DGFASLI, NSC, ASSE, HSE, OSHA-NEBOSH – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge safety incentive scheme, safety campaign.	8
Total			**42**

4. Reading

4.1 Textbooks:

1. Guidelines for Auditing Process Safety Management Systems, Second Edition, Author(s): Center for Chemical Process Safety.
2. Mckinnon, R.C. The Design, Implementation, and Audit of Occupational Health and Safety Management Systems,2020.
3. Stephen, A. Health and Safety, Environment and Quality Audits: A Risk based Approach, Stephen Asbury.3rd edition, 2018.
4. IS 3786: Methods for computation of frequency and severity rates for industrial injuries and classification of industrial accidents By Bureau of Indian Standards.

5. Outcome of the Course:

On completion of this course, students will be able to

1) Understand accident investigation methodologies and apply systematic procedure to identify the root causes of incident.
2) Carry out fire safety audit, incident investigation being a fire safety auditor, advisor, investigator, and recommend suitable control measures.
3) Formulate recommendations for corrective action recommendations, make audit reports, and conduct follow-ups.

Modeling and Simulation of Enclosure Fires

1.1 Course Number: FSE213
1.2 Contact Hours:3-0-0 Credits:9
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Basic Fire Science and Fundamentals of Fire Engineering
1.5 Syllabus Committee Members: Dr. Nilambar Bariha & Ms. Ananya Borah

2. Objective:

i) To understand about the physical models for turbulence, heat transfer, combustion production of gaseous species, flame spread and soot in compartment fire.
ii) To provide knowledge of how the spread of fire and combustion gases is simulated using Computational Fluid Dynamics (CFD).
iii) To understand the limitations of the numerical and physical models used in modeling of compartment fires.

3. Course Content:

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-Topic	Lectures
1	**Description of Enclosure Fires**	Introduction, General Description of the Process of Combustion, Fire Growth in an Enclosure, Stages in Enclosure Fire Development, Fire Development in Terms of Enclosure Temperatures and Flow through Openings, Factors Influencing Fire Development in an Enclosure, Factors Controlling Energy Release Rates in Enclosure Fires, Burning Rate and Energy Release Rate, Enclosure Effects, Energy Release Rates Based on Free Burn Measurements. Design Fire- Background, Growth Phase, Steady Phase, and Decay Phase.	12
2	**Fire Plumes and Flame Heights**	Flame Characteristics, Turbulent Fire Plume Characteristics, Ideal Plume-Assumptions, Initial Considerations, Continuity Equation for Mass, Momentum and Buoyancy Equation, Plume Equations Based on Experiments- Zukoski Plume, Heskestad Plume, McCaffrey Plume, Wall and Corner Interactions with Plumes, Line Source Plumes. Ceiling Jets- Ceiling Jet Temperatures and Velocities, Flame Extensions under Ceilings.	11
3	**Pressure Profiles and Vent Flows for Well-Ventilated Enclosures**	Characteristics of Pressure, Application to a Simple Example, Mass Flow Rate through Vents, Pressure Profiles in a Fire Room with a Vent, Well-Mixed Case- Mass Flow Rates and Height of the Neutral Plane, Mass Flow Rate in through an Opening, Taking into Account the Mass Produced in the Room (the Burning Rate), Stratified Case-Mass Flow Rates.	6
4	**Computer Modeling of Enclosure fire**	Thermodynamics, equation of state, chemical and phase equilibrium, Pressure Poisson equation, Scalar transport schemes, non-dimensional forms of the governing equations, Compressible and low-Mach number, thermal radiation.	8

5	**Simulation in Enclosure fire**	Basic Simulation Approaches, Handling Stepped and Event-based Time in Simulations, Extinction, ignition, under-ventilated combustion, toxic products (CO, soot), Fire suppression, Model validation and uncertainty quantization (model input and output).	**5**
Total			**42**

4. Reading

4.1 Reference Books:

1. Janssens, M.L., Introduction to Mathematical Fire Modeling, 2nd Edition, Technomic Publication, CRC Press, 2000.
2. Karlsson, B., Quintiere, J.G., Enclosure Fire Dynamics, 1st Edition, CRC Press, 1999.
3. Yeoh, G.H., Kwok Kit Yuen, K.K., Computational Fluid Dynamics in Fire Engineering: Theory, Modelling and Practice, Butterworth-Heinemann, Elsevier Publication, 2008.
4. Cox, G., Combustion Fundamentals of Fire, Academic Press Inc., 1995.
5. Delichatsios, M.A., Air Entrainment into Buoyant Jet Flames and Pool Fires, SFPE Handbook, 1st Edition, (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-19.
6. Emmons, D.D., Ceiling Jet Flows, SFPE Handbook, 1st Edition, (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-8.
7. Evans, D.D., Ceiling jet flows, SFPE Handbook, 1st Edition, (Society of Fire Protection Engineers, Boston), 1988, Ch. 1-9.

5. Outcome of the Course:

After completion of the course, the students will be able to-

1) Learn about the basis of mathematical models involving algebraic and differential equations used in compartment fires.
2) Learn about the target affected in each damage state and the associated time at which occurs in CFD.
3) To estimate the yield & calculation the species concentration of smoke in fire.

Fire Ground Operations-II

1.1 Course Number: FSE214L
1.2 Contact Hours:0-0-2 Credits:2
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Fire Ground Operation-I
1.5 Syllabus Committee Members: Ms. Ananya Borah &Dr. Nilambar Bariha

2. Objective:

i) To provide in-depth knowledge about the various Tenders and operations and the different firefighting system used in Industry.
ii) To be familiar with various regulations, safety procedures, equipment, techniques and personnel necessary to operate at a confined space emergency.
iii) To make the students understand the various rescue procedures and techniques used during the time of emergency.

3. Course Content:

Sl.No.	List of Experiments
1	Fire Water Pumps- Components, Types and Methods of Operation.
2	Sprinkler System- Types, Working Principle and Method of Operation.
3	Sprinkler Head- Types and Color Coding.
4	Foam- Types of Foam Compound and Their Classification.
5	Operation of Fire Water and Foam Monitors.
6	Selection, Operation, Maintenance and Hydro test of Fire Hose.
7	Demonstration of Self-Contained Breathing Apparatus (SCBA).
8	Confined Space Entry Procedures.
9	Use of Portable Multi-Gas Detector.
10	Work Permit System- Types and Procedures.
11	Demonstration of Mock drills and Rescue Operation.
12	Personal Protective Equipment's- Types and Uses.
13	Fire Tender- Components, Types and Method of Operation.
14	Fire Alarm System- Components, Types and Method of Operation.

4. Outcome of the Laboratory:

After completion of this course, the students will be able to

1) Handle emergency situations efficiently by using different rescue procedures.
2) Know the concepts of personal protective equipment and its usages.
3) Gain an overview of work permit systems.

Simulation of Fire Laboratory

1.1 Course Number: FSE215L
1.2 Contact Hours:0-0-2 Credits:2
1.3 Semester-offered: 2nd Year –Even
1.4 Prerequisite: Fire Dynamics and Smoke Management System
1.5 Syllabus Committee Members: Dr. Nilambar Bariha and Ms. Ananya Borah

2. Objective:

i) To familiarize students with the actual scenarios of the compartment or enclosure fire.
ii) To understand the fire dynamics and smoke movement in any building.
iii) To analyze the thermal radiation and smoke movement which are useful to plan a rescue for the building.
iv) To plan the evacuation, movement of smoke, and air circulation for the complex architectural building design

3. Course Content:

Sl.No.	List of Experiments
1	To create a model geometry of given enclosures data.
2	To define the fire and its thermal conditions inside the enclosures.
3	To create a mesh and define boundary conditions of given enclosure data.
4	To define the simulation parameters of given enclosures data.
5	To define the simulation time-steps and viewing the results of given enclosures data.
6	Modeling heat conduction problem in PyroSIM.
7	Simulation of Burner Fire using PyroSIM.
8	Modeling of Smoke Movement in Building by using PyroSIM.

4. Outcome of the Laboratory:

On completion of this course, the students will

1) To learn about the actual scenarios that may be happening in the compartment fire of simulation. They design the plan for evacuation in buildings in case of any fire.
2) To learn about the movement of fire and smoke through simulation which are useful for fire fighter to rescue the people.